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Protection of Insect Pheromones from Degradation by Ultraviolet Radiation /‡c

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PC 6618

PROTECTION OF INSECT PHEROMONES FROM DEGRADATION BY ULTRAVIOLET RADIATION

ABSTRACT OF THE DISCLOSURE

A substituted benzene compound was found to protect an insect pheromone against ultraviolet (UV) radiation degradation. The UV absorbing material significantly extended the biological activity and quality of the pheromone while at the same time remaining nontoxic to the insect and nondestructive of the environment.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

This invention relates to the treatment of pheromones and other naturally secreted substances to resist degradation. More specifically, this invention relates to the treatment of pheromones and other naturally secreted substances to resist degradation by ultraviolet radiation.

(2) Description of the Prior Art

The destruction and damage caused by insects to food, feed, seed, and fiber has reached a critical level. Current deemphasis of the use of pesticides and other potentially hazardous materials to aid in the control of insect populations has rendered it imperative that appropriate alternatives become established. An approach which is of considerable interest is that of using insect pheromones in baits or traps to attract, repel, inhibit, or otherwise confuse members of a particular species. Unfortunately, many of these compounds, including natural and synthetic sex pheromones, are rather rapidly degraded when exposed to air and sunlight. Efforts to

stabilize insect sex pheromones have centered primarily on incorporating antioxidation compounds with the pheromone. However, some of the antioxidants in use have suspected carcinogenic properties, and this might preclude their continued use or further development.

SUMMARY OF THE INVENTION

This invention provides a method for protecting animal pheromones from decomposition by ultraviolet radiation. By the process of this invention pheromones are formulated with substituted benzene compounds which protect against ultraviolet radiation degradation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

We have found that some substituted benzene compounds protect insect pheromones against ultraviolet radiation degradation.

To determine the efficacy of compounds used to prevent ultraviolet degradations, some performance requirements that should be considered are:

(1) They must not impede, impair, disrupt, or otherwise degrade the biological activity of the pheromones.

(2) They must not be toxic or cause dermatitis or irritation, etc., to the users of these compounds.

(3) They must not cause, directly or indirectly, any adverse environmental effects.

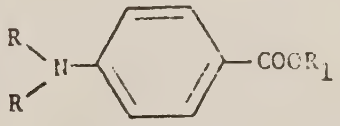
(4) They must be easy to apply to various substrates and neither damage nor cause to be damaged any said substrate.

(5) They must effectively protect pheromones from the damaging UV radiation of sunlight for a reasonable length of time--20-30 days.

Effectiveness in the treatment of insect pheromone is tested by exposing members of the opposite sex, under controlled conditions, to the pheromone-UV absorbing compound for a specified time interval. Positive response is determined by attraction, mating, or precopulatory behavior and by the relative strength of these responses.

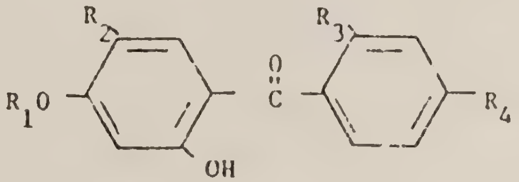
It is an object of this invention to provide a method of treating pheromones and other naturally secreted substances or synthetically produced substances in order to provide more UV radiation resistance and to prolong the effectiveness of these substances.

In general, according to this invention, pheromones are protected from degradation by combining them with one of several substituted benzene compounds such as the derivatives of -aminobenzoate, -benzophenone, -phenyl acrylate of the following general formulas:



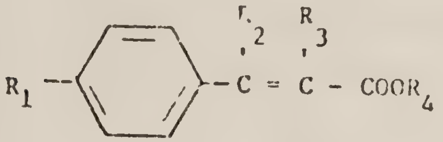
wherein R is H or an alkyl group of 1 to 2 carbon atoms, and R_1 is H, straight or branch chained alkyl group of 2 to 8 carbon atoms with or without OH and alkoxy substitutions of 2 to 3 carbon atoms.

or



wherein R_1 is H or alkyl group of 1 to 12 carbon atoms, R_2 is H, sulfonic acid or its sodium salt, R_3 is H or OH, and R_4 is H, OH, or methoxy group.

or



wherein R_1 is H or alkoxy group of 1 to 2 carbon atoms, R_2 is H or phenyl group, R_3 is H, CN, or methylcarboxyl group, R_4 is alkyl group of 1 to 2 carbon atoms of straight chain or 2 to 6 carbon atoms with β-substitution of alkyl or alkoxy group of 1 to 2 carbon atoms or α- and β-OH substitutions;

or other such compounds considered to be "UV absorbers."

In addition, such UV absorbing compounds should have incorporated into the esters and mixtures of esters a relatively small proportion of a material or materials which will inhibit the decomposition of said compounds. Inhibitory materials would include citric acid, ascorbic acid, hydroquinone, butylated hydroxyanisole, butylated hydroxytoluene, and any other type of antioxidant or mixture. Inclusion of an inhibitory material or materials is essential only if required to prevent decomposition products of the UV absorbing compound, caused by oxidation in the presence of light, from forming.

The following examples illustrate but do not limit the scope of this invention.

Example 1

The synthetic sex pheromone, (Z,E)-9,12-tetradecadienyl acetate, 95% purity, of the Indian meal moth, Plodia interpunctella, was diluted in hexane (1:100). One µl of this solution was placed on each of 3 filter paper discs (2 cm dia.) and served as a control. To another aliquot of the diluted solution an equal volume of 2-ethylhexyl para-dimethylaminobenzoate (Escalol 507, Van Dyk & Co.) was added. Two µl of this resulting solution were placed also on each of 3 filter paper discs (maintained equal conc. of pheromone with controls). The discs were then exposed to UV radiation (253 nm.) from two 15-watt germicidal lamps, GE 15T8, in each of 2 lamp fixtures. Exposure times consisted of sixteen 3-hr periods. Bioassays (conducted after each exposure period and under chemical hood) were made with 48-hr-old unmated male P. interpunctella as previously reported. The criterion for a positive response of the males was fluttering behavior within 60 sec. After each bioassay discs were placed separately in sealed jars. Test results (Table I) indicated substantial protection after 33-hr total exposure time (> 50% male response); control discs had no biological activity after 3-hr exposure, which substantiated earlier tests.

Example 2

Solutions for field testing were formulated as previously mentioned except that they were dispensed at 100 times the laboratory rate onto sponge rubber discs (2 cm dia. x 0.5 cm thick) and suspended out of doors to be exposed to sunlight.

Discs remained under field conditions 24 hr/day except during the bioassays for a total of 48 days. Test results (Table II) indicated significant protection afforded by 2-ethyl hexyl para-dimethylaminobenzoate when compared with controls.

In addition, this UV absorbing compound was found to have no effect on the behavior of the male moths. This compound also was observed to offer substantial protection in a 1:1 pheromone-UV absorber formulation

TABLE I

Condition of Disc	% Males responding																	
	Hr. exposed to UV radiation																	
	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	49	51
Pheromone + UV absorber	100	92	92	92	100	100	100	89	92	84	67	73	44	15	3	11	0	0
Pheromone only...	100	0	0	0	0	0	0*											

*Bioassay discontinued after 18 hr.

TABLE II

ondition of disc	% Males responding								
	Days exposed to sunlight and air								
	0	6	8	15	22	27	36	41	48
Pheromone + UV absorber...	100	86	82	96	89	60	29	22	51
Pheromone only...	100	3	11	3	0	0*			

*Bioassay discontinued after 27 days.